For example, a laser 102 may provide an optical beam 114 to a first gate 104a. An input bit 105a matching stored bit 115a may open the gate 104a, therefore providing an optical beam at the output 116a. A delay device 220a may be set up to delay the input bit 105b to provide a delayed input bit 222a, thereby opening the gate 104b with the correct timing to receive the output 116a. Accordingly the optical beam 116a may be passed through the gate 104b, therefore providing an optical beam at output 116b.

In a similar manner, a second delay device 220b may be set up to delay the input bit 105c to provide a delayed input bit 222b, thereby opening the gate 104c with the correct timing to receive output 106b. Thus, by pipelining the bits 105a-c, the gates 104a-c may be opened and light passed therethrough in an efficient manner.

From the above discussion, it will be appreciated that the present invention provides a recirculating frequency-stacked optical memory which may be used to randomly access optical information packets. In addition, the present invention provides an optical-content-addressable memory that may also be used in high-speed optical communication devices. These may be used in diverse optical communication devices, including routers where information must be disassembled and reorganized in order to be re-transmitted to a correct destination.

The present invention may be embodied in other specific forms without departing from its essential characteristics. The described embodiments are to be considered in all respects only as illustrative, and not restrictive. The scope of the invention is, therefore, indicated by the appended claims, rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.

What is claimed and desired to be secured by United States Letters Patent is:

1. An apparatus for optically storing information, the apparatus comprising:

a first input line configured to transmit first and second optical information at a first frequency;

a recirculating loop configured to receive and circulate the first optical information from the first input line;

a first frequency shifter connected in the recirculating loop and configured to frequency-shift the first optical information; and

the recirculating loop, further configured to provide a frequency-stacked signal by receiving and circulating the second optical information concurrently with the first optical information.

2. The apparatus of claim 1, further comprising:

the first frequency shifter, further configured to frequency-shift the frequency-stacked signal; and

the recirculating loop further configured to integrate a third optical information into the frequency-stacked signal by receiving and circulating a third optical information at the first frequency.

3. The apparatus of claim 2, further comprising:

a second frequency shifter connected to re-locate the first optical information at the first frequency by shifting the frequency-stacked signal; and

a third frequency shifter connected to re-locate the second optical information at the first frequency by shifting the frequency-stacked signal.

4. The apparatus of claim 3, further comprising:

a first filter operably connected to pass substantially only the first optical information from the frequency-stacked signal; and

a second filter operably connected to pass substantially only the second optical information from the frequency-stacked signal.

5. The apparatus of claim 4, further comprising an amplifier connected in the recirculating loop, the amplifier configured to amplify the frequency-stacked signal to reduce signal degradation.

6. The apparatus of claim 5, further comprising a frequency shift controller connected to control the first frequency shifter.

7. The apparatus of claim 6, wherein the recirculating loop further comprises a low pass filter configured to reduce signals corresponding to any frequencies above a limiting frequency.

8. The apparatus of claim 6, wherein the recirculating loop further comprises a high pass filter configured to reduce signals corresponding to any frequencies below a limiting frequency.

9. The apparatus of claim 2, further comprising a tunable filter operably connected to pass at least one of the first, second, and third information selected from the frequency-stacked signal.

10. The apparatus of claim 9, further comprising a detector and a laser, the detector operably connected to receive the information from the tunable filter and configured to modulate the laser therewith.

11. A method for storing optical information, the method comprising:

receiving first and second optical information, each having a first frequency associated therewith;

receiving and circulating the first optical information within a circulating loop;

frequency-shifting the first optical information; and

receiving and circulating the second optical information within the circulating loop to provide a frequency-stacked signal containing the first and second optical information.

12. The method of claim 11, further comprising:

frequency-shifting the frequency-stacked signal; and

providing a third optical information to the circulating loop and integrating the third optical information in the frequency-stacked signal.

13. The method of claim 12, further comprising:

receiving the frequency-stacked signal from the circulating loop;

frequency-shifting the frequency-stacked signal to re-locate the first optical information at the first frequency;

receiving the frequency-stacked signal from the circulating loop; and

frequency-shifting the frequency-stacked signal to re-locate the second optical information at the first frequency.

14. The method of claim 13, further comprising filtering the frequency-stacked signal to extract therefrom the first optical information and the second optical information.

15. The method of claim 14, further comprising amplifying the frequency-stacked signal to reduce signal degradation.

16. The method of claim 15, further comprising controlling, by a frequency-shift controller, the frequency-shifting within the circulating loop.

17. The method of claim 16, further comprising low-pass filtering the frequency-stacked signal to reduce any frequencies above a pre-selected frequency.

18. The method of claim 16, further comprising high-pass filtering the frequency-stacked signal to reduce any frequencies below a pre-selected frequency.

19. The method of claim 12, further comprising:

receiving the frequency-stacked signal from the circulating loop;

tuning a filter therefor; and

filtering, by the tunable filter, at least one of the first, second, and third optical information from the frequency-stacked signal.

20. The method of claim 19, further comprising:

detecting the selected optical information; and

modulating a laser in accordance therewith.